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A STUDY OF SMALL GROUP DYNAMICS AND PRODUCTIVITY IN THE BSCS LABORATORY BLOCK PROGRAM.

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THE RELATIONSHIP BETWEEN SMALL GROUP COMPATIBILITY AND ACHIEVEMENT IN THE BIOLOGICAL SCIENCE CURRICULUM STUDY LABORATORY BLOCK PROGRAM WAS TESTED. STUDENTS IN 14 CLASSES FROM FOUR HIGH SCHOOLS WERE ASSIGNED TO FOUR-MEMBER LABORATORY GROUPS CLASSIFIED AS COMPATIBLE OR INCOMPATIBLE. GROUP CLASSIFICATION WAS VALIDATED BY OBSERVERS WHO WERE NOT AWARE OF THE INITIAL CLASSIFICATION. THE TWO CATEGORIES OF GROUPS WERE EQUATED FOR SCHOLASTIC ABILITY AND BIOLOGY ACHIEVEMENT. DATA INCLUDED EFFICIENCY RATINGS AND PARTICIPATION INDEXES DETERMINED BY OBSERVERS, AND FINAL TEST RESULTS. SPEARMAN RANK ORDER CORRELATIONS BETWEEN PREDICTED GROUP COMPATIBILITY SCORES, BIOLOGICAL SCIENCE CURRICULUM STUDY BLUE VERSION FINAL EXAMINATION SCORES, MEAN GROUP EFFICIENCY SCORES, AND GROUP PARTICIPATION INDEX SCORES WERE DETERMINED. THE PERFORMANCE OF INCOMPATIBLE GROUPS IN COLLEGE-BOUND CLASSES TENDED TO BE HIGHER THAN THOSE IN COMPATIBLE GROUPS. PERFORMANCE OF NONCOLLEGE-BOUND STUDENTS TENDED TO INCREASE WITH PREDICTED COMPATIBILITY. THIS ARTICLE IS PUBLISHED IN THE "JOURNAL OF RESEARCH IN SCIENCE TEACHING," VOLUME 4, ISSUE 2, 1966. (AG)

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The amount of work accomplished in the laboratory is often dependent upon the efficiency of group work. Here is an attempt to determine factors which may inhibit productivity of small group efforts.

A Study of Small Group Dynamics and Productivity in the BSCS Laboratory Block Program

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When individuals interact together in groups, we may describe what happens by making three classes of statements. Once class of statements uses the individual as the unit of analysis. This class of terms describes the behavior, achievements, and characteristics of each person in the group. The second class of statements, on the other hand, employs the group as the unit of analysis. These statements assume that the group is an entity with unique properties not necessarily represented by a simple sum of member properties. We can conceive of a third class of terms which relate the two classes with their different units of analysis to each other, e.g., descriptions of what happens to an individual by virtue of his participation in a group or, conversely, what happens to a group as a result of each person's interactions with it. Thus, for example, we may describe a certain student in the Biological Sciences Curriculum Study (BSCS) as a quiet, hard worker with a B+ average (class one statement). If he is now assigned to work in the laboratory with three other students, we may talk about the laboratory data produced by the group or about the errors made by the group (class two statement). Finally we may note that the behavior of our student changes after he enters the group. He refuses to work regularly; he is often argumentative; other members of the group address an increasing number of negative communications to him (class three statement).

In the BSCS Laboratory Block program, students typically work in groups of four every day for approximately six weeks. These groups are, by intent at least, task-oriented. To complete the BSCS laboratory activities in a reasonable time, each group must delegate tasks and responsibilities to its various members and then must count on the members to perform those tasks correctly, with dispatch, and sometimes in specified sequences. Occasionally, data produced by each of the groups in a classroom are pooled, via the blackboard, in order to build up a reasonable sample for computational purposes. Thus, at times, the production of a group becomes public information and errors in data can affect all other groups.

Observation of BSCS laboratory groups in four high schools for two years indicated that while most groups operated smoothly, every classroom had some incidence of groups that seemed to suffer from organizational problems severe enough to cause delay in the completion of tasks. The incidence of groups with such problems varied from 15% in some classrooms to 50% in other classrooms. While smooth working units delegated and sequenced tasks effectively, as indicated by their low rate of error and the

time-to-completion of experiments, groups with organization problems consumed working time trying to delegate tasks and clarify procedures. These latter groups made more errors per experiment* and often fell behind schedule, i.e., they were less efficient than their counterparts who had few problems of organization. In addition, the two kinds of groups behaved differently in the face of error. Smooth working units generally set about reexamining their procedures, but problem groups usually engaged in a form of scapegoat action, that is, 'well' groups asked, "What went wrong?" and 'sick' groups asked, "Who did wrong?"

In a *post hoc* analysis of group characteristics, the investigators sought to determine whether factors of intelligence, sex, or basis of grouping could reasonably account for the differences between the two species of groups that appeared to be in the population. We asked, for example, whether more efficient groups had a higher mean intelligence as measured by the SCAT (Scholastic Aptitude Test) and rejected that hypothesis. We asked whether the incidence of 'Sick' groups was higher in all male groups, in all female groups, or in mixed groups and found sex not to be an explanatory factor. We then examined the various bases on which teachers formed groups. Units in some classrooms consisted of self-chosen members. In other classrooms, teachers assigned students to groups. The incidence of 'Sick' groups appeared to be as high for one method of forming groups as for the other.

We found ourselves, then, in the position of recognizing a phenomenon and lacking a theory to explain it or to guide us in bringing it under control. The instructional problem confronting us was to find a way to form task-oriented laboratory groups that optimized group performance and minimized the occurrence of 'Sick' groups. Unfortunately, the *post hoc* analyses left use with no working hypotheses.

We turned then to an examination of need theory and its relation to theories of small group dynamics. In groups where needs of members are frustrated, productivity probably would be lower than for groups where need satisfaction is higher. We assumed that the important needs individuals exhibit with respect to the criterion of group productivity relate to *control* (power) and possibly to *inclusion* (interaction). By comparing, for example, A's description of how much control he wants from others with B's description of how much control he tries to exert, a measure of mutual satisfaction could be obtained. According to a theory put forward by Schutz, the following proposition might apply to the BSCS task-oriented groups, and we sought to test its applicability.

If the compatibility of one group, "a," is greater than that of another group, "b," then the achievement of "a" will exceed that of "b."

Compatibility is a property of relations among individuals that leads to mutual satisfaction of needs and facilitates the progress of group tasks. It has mainly to do with ability to work together successfully. (It is important to note, however, that compatibility does *not* necessarily imply liking.) The less compatible the relations in a group are, the more time the group must spend in finding ways of dealing with the difficulties. Interpersonal difficulty is likely to be converted into task difficulty. Thus incompatible groups have less time and energy available to devote to the laboratory tasks.

The criterion of exactness in the definition of compatibility was met by defining types of compatibility in mathematical terms. Schutz regards each of the needs as a kind of commodity to be exchanged. He assumes that each individual seeks to establish an optimal relation between himself and others in each need area, that is, a person wants to act a certain way toward others and wants to be acted toward in a certain way. Conflict arises in the *Control* (*C*) area, for example,

* Mistakes occurred largely in procedures such as taking measurements or failing to take them; misuse of equipment; discard of solutions prematurely; omission of some steps; etc.

when members disagree on the amount of interchange of the power commodity. We may observe conflict within BSCS laboratory groups between the conformist and the rebel. The conformist wants to follow laboratory manual procedures and will brook no changes (high *C* interchange individuals accept authority and seek to enforce it). The rebel, on the other hand, wants to tamper with procedures but does not want to force changes on the group (low *C* interchange individuals neither accept authority nor seek to exert it over others).

Schutz[3] developed an instrument, the FIRO-B,* which yields two scores in each of the need areas of interest to us, namely, *Control* (power) and *Inclusion* (interaction).† One score measures the amount of that behavior (commodity) a person wants from others (*w*). The second score describes the amount of the behavior he exhibits to others (*e*).

Of the three kinds of compatibility defined by Schutz, *Interchange Compatibility* seemed most relevant for groups larger than two. Interchange Compatibility (xK_{ij}) assumes that the amount of interchange an individual desires may be measured by combining his scores on both the *expressed* (*e*) and *wanted* (*w*) scales in a need area.

$$xK_{ij} = |(e_i + w_i) - (e_j + w_j)|$$

That is, given the scores of two individuals, *i* and *j*, on the *e* and *w* scales in each need area, the *interchange score* ($e_i + w_i$) for each is obtained by summation. Since the more similar two persons' scores are, the more compatible they are (i.e., they agree on the amount of exchange of the commodity), compatible groups can be formed by putting together individuals with similar interchange scores. Incompatible groups can be formed by putting together individuals with interchange scores which differ by large amounts. The smaller the value of xK_{ij}, the greater will be the interchange compatibility. For groups larger than two, a dispersion measure describes the groups. Groups with low variance will be more compatible than groups with high variance.*

TABLE I
Intercorrelations among FIRO-B Control and Inclusion Scales

Scale	C_e	C_w	I_e	I_w
C_e		0.247	0.220	0.250
C_w	0.247		0.184	0.166
I_e	0.220	0.184		0.551
I_w	0.257	0.166	0.551	$N = 268$

C_e expresses control behavior; C_w wants to be controlled; I_e tries to be included in groups; I_w wants to be included.

Based on scores in the Control area, students in fourteen classrooms in four high schools were assigned to groups of four members each. According to the size of the variance of the xK for a group, the group was assigned either to a compatible or to an incompatible category. Twenty-nine groups were predicted to be compatible and 29 were predicted to be incompatible. To test the compatibility–achievement hypothesis, the two categories of groups were equated both with respect to ability (SCAT) and to performance on Achievement Test 3 for the BSCS Blue Version biology.

The decision to use C_e and C_w as the only basis for forming compatible and incompatible groups and to reserve I_e and I_w (Inclusion) scores for possible *post hoc* analysis can be explained by reference to the figures in Table I. The FIRO-B contains nonindepen-

* The FIRO-B (Fundamental Interpersonal Relations Orientations–Behavior) uses Guttman scaling and produces a maximum score of 9 each for the expressed (*e*) and wanted (*w*) behaviors in each need area.

† The FIRO-B measures three need areas: Control, Inclusion, Affection (*A*). The reliability of the *A* scale for the population in this study caused us to drop that scale from consideration. *C*-scale reliability was 0.87 and I-scale reliability was 0.78. The 18 items of the *C* scale served as the principal basis for forming groups.

* Schutz defines two other kinds of compatibility as follows:
Reciprocal compatibility: $rK_{ij} = |e_i - w_j| + |e_j - w_i|$
Originator compatibility: $0K_{ij} = (e_i - w_i) + (e_j + w_j)$.

TABLE II
Mean Scores and Standard Deviations on FIRO-B Control and Inclusion Scales by School and by Sex

FIRO-B scale	School						Sex			
	A		*B*		*C*		Males		Females	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
C_e	2.86[a]	2.14	3.62	2.25	3.63	2.30	3.56	2.24	2.98[b]	2.21
C_w	4.40	2.31	4.45	2.44	4.35	2.14	4.50	2.54	4.26	1.95
I_e	4.99	2.17	5.18	2.40	4.88	2.52	4.80	2.41	5.46	2.18
I_w	3.57	3.38	4.85	3.44	4.15	3.46	3.86	3.40	4.82	3.51
N	102		114		52		165		103	

[a] Difference is significant beyond the 0.005 level.
[b] Difference is significant beyond the 0.05 level.

pendent scales. The correlation between the I_e and I_w scales is much higher than the correlation between the C_e and C_w scales. That is, how one acts in the Inclusion area is similar to how one would like to be acted toward. In the Control area, on the other hand, there is a clear distinction between how one tries to act and how one would like to be acted toward. In addition, there is empirical evidence from other studies for role differentiation in the *C* area (e.g., teachers and army officers score differently on the *C* scales).

To validate the designation of groups as compatible or incompatible, classroom observers who did not know how a group had been classified on the FIRO-B described each group and characterized it as either compatible or incompatible at the end of the first week of observation. Overall agreement between observers and the FIRO-B predictions was 0.82. Agreements on ratings among observers and between observers and FIRO-B at schools *B* and *C* were considerably higher than at school *A*. At school *A*, observers tended to rate groups predicted to be incompatible as compatible. Examination of Table II will show that school *A* differs significantly from schools *B* and *C* on the C_e scale, i.e., the extent to which individuals make an effort to gain control of a group or a task situation. Students at school *A* exhibit less expressed control behavior.

In addition, observers employed the twelve categories developed by Bales[4] for the study of behavior in small face-to-face groups. The twelve categories can be divided into two classes, one of which includes tallies of all Task-Oriented (TO) behaviors and the other of which includes all responses that belong to the area broadly defined as Social–Emotional (SE). The Social–Emotional category contains two subsets of three categories each: one subset includes *positive* behaviors such as giving help or reward, agreement or using humor to reduce tension; the second subset contains categories with behaviors such as rejection, withdrawal, or antagonism and is thus designated as *negative* in orientation. One hypothesis to be tested was that compatible groups would spend relatively more time on problems of task orientation, evaluation, and control (TO). Incompatible groups would devote relatively more time to problems of tension-management, integration, and decision (SE). The hypothesis is supported at the 0.10 level in schools *B* and *C*, but at school *A*, quite another thing happens. At school *A* incompatible groups resort to task-oriented behavior to reduce tension. That is, the ratio SE/TO tends to be small for incompatible groups in school *A* while it tends to be large for incompatible groups in the other two schools. In addition, an examination of the distribution of positive SE and negative SE tallies suggests that when confronted with task difficulties both compatible and incompatible groups in schools *B* and *C* show increases in the −SE/

TABLE III
Mean Scores and Standard Deviations on the TOUS Test, by Schools and Sex

	School						Sex			
	A		*B*		*C*		Males		Females	
Test	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
TOUS 1	8.27	3.40	11.77	2.78	11.46	4.24	10.36	3.75	10.42	3.70
TOUS 2	9.96	3.23	11.76	2.46	10.92	4.13	10.72	3.10	11.22	3.44
TOUS 3	9.09	3.63	12.53	3.51	12.40	4.91	11.50	4.31	10.72	3.99
TOUS Total	27.32[a]	8.94	36.07	6.96	34.79	12.36	32.58	9.79	32.36	9.98
N =	102		114		52		165		103	

[a] Difference is significant beyond the 0.002 level. N = 268

TABLE IV
Spearman Rank Order Correlations between Predicted Compatibility and (*A*) Final Test, (*B*) Mean Efficiency Rating, (*C*) Participation Index

			Noncollege-bound					College-bound		
			a	*b*	*c*			*a*	*b*	*c*
School	Class	Group N	Teacher test, rho	Mean efficiency, rho	Participation, rho	Class	Group N	Teacher test, rho	Mean efficiency, rho	Participation, rho
A	3	4	1.00[a]	0.40	0.40	2	5	0.40	−0.90[a]	−0.90[a]
	4	7	0.86[a]	0.04	0.39					
	5	5	0.78[a]	0.30	0.70					
	1	6	0.00	0.23	0.60					
B	6	7	0.71[a]	0.29	0.39	7	7	−0.80[a]	−0.18	0.05
	9	7	0.43	0.83[a]	0.72[a]	8	7	0.20	0.56	0.18
C	10	5	0.50	0.09	0.70	11	4	−0.30	−0.20	−0.40
						12	5	−0.50	−0.40	−0.50

[a] Significant at ≥0.10 (one-tail test).

Note: Criterion *a:* Positive correlation (rho) means test performance tends to improve as (predicted) *incompatibility* increases, i.e., as one moves from compatible to incompatible. Criterion *b:* Positive correlation (rho) means efficiency ratings improve as (predicted) incompatibility increases. Validation of FIRO-B predictions *c:* Positive correlation (rho) means the ratio of member participation increases as incompatibility increases.

+SE ratio but groups in school *A* show a decline in the ratio. As frustration builds up, the groups reduce tension in different ways. At schools *B* and *C* negative behavior increases, but at school *A* positive reactions such as compliance and joking increase.

Examination of Table III lends further support to the evidence that the population at *A* differs from the population at *B* and *C*.*

* School *A* consisted primarily of three minority groups, Negro, Mexican–American, Oriental. It is interesting to note that the mean C_s for school *A* is significantly lower than the mean C_s at the predominantly white schools, *B* and *C* (see Table II).

Table III reports the means for the three subtests of the TOUS (Test on Understanding Science).

Criterion Measures

A. Final Examination (Table IV, Column a)

One criterion for assessment of group performance was taken to be the group mean on the final examination constructed by the teachers in the BSCS Blue Version Test Center. All classes took the same final examination which consisted of multiple

choice items designed to test knowledge of the content and procedures of the laboratory block. If our hypothesis that compatible groups achieve more than incompatible groups was to have been supported, there should have been a positive correlation between mean test performance per group and the compatibility score for each group. Spearman rank order correlations between the final test means and the compatibility scores for groups in each classroom produced a surprising result. As shown in Table IV, column *c*, school *A* reversed the prediction. In four of the five classes, mean group performance increased as *incompatibility* increased. In schools *B* and *C*, results seemed confusing. Four classes showed clear reversal of the prediction, but correlations for two other classes supported the expectation, i.e., performance was higher as compatibility increased. The distinction between classes seemed to relate to whether the class was 'college-bound' or 'noncollege-bound.'* To put it in other terms; performance of groups in college-bound classes tended to be higher on the final test criterion when predicted compatibility increased; performance of groups in noncollege-bound classes definitely tended to increase as predicted *incompatibility* increased.

B. Group Efficiency (Table IV, Column b)

Observers in the classrooms assigned an efficiency rating to each group twice each week. Efficiency included consideration of time from the start of the laboratory period until the group started to work, time-to-completion of laboratory experiments, and the number of mistakes made, if any. The observer assigned each group some number from *1* to *n*, where *n* was the number of groups in the classroom. An assignment of *1* referred to the group judged most efficient, *2* to the group judged next in rated efficiency, etc. Mean ratings were computed. Spearman rank order correlations between predicted compatibility and mean efficiency ratings again suggest that some distinction exists in the behavior of college-bound versus noncollege-bound classes.

For college-bound classes, efficiency tends to be positively correlated with compatibility. For noncollege-bound classes, on the other hand, efficiency tends to be negatively correlated with compatibility (see Table IV, Column *b*).

Descriptions of group behavior kept by the observers supports the proposition that groups in the two kinds of classes, college and noncollege, resolve difficulties differently. Noncollege groups seem to reduce tensions by increasing task activity. Observers note that following a heated argument there is a period of concerted task behavior. Examination of −SE/TO ratios derived from application of the Bales categories mentioned earlier confirms the suggestion that such groups reduce tension by turning to task behavior. It may well be that the task area has low emotional valence for them, i.e., it is the safest zone to retreat to since outcome in terms of grades is less important than to the college-bound population.

College groups, by contrast, reduce tension by temporarily leaving the group (wandering off to watch other groups) or by engaging in more negative (−SE) behavior. Concerted task behavior drops, and it is common to find in such groups one or two people doing the work. Some members of incompatible, college groups return to the laboratory at noon or after school or early in the morning to repeat laboratory work. The reason most often given for such behavior is "I don't trust the work of those guys." For college-bound groups, achievement and grades may have high emotional valence, i.e., the use of social-emotional devices (SE) to reduce tension may be less costly.

C. Participation Index (Table IV, Column c)

At this time, admittedly, the explanation for the difference in the group dynamics of college- and noncollege-bound classes

* 'College-bound' refers to classes so designated by counselors and characterized by higher mean scores and smaller standard deviations on the Scholastic Aptitude Test (SCAT).

amounts to little more than conjecture. It should be noted, however, in Table IV, column *c*, that the correlation of the participation index with incompatibility tends to be positive for noncollege groups and low or negative for college groups. This index was constructed from scores assigned a group on an 8-point scale that described member participation. Low scores (e.g., 0–1) meant high participation by all members or most members. High scores meant low participation by most members or failure of groups to get tasks accomplished because members would not accept task responsibilities. Except in two cases, the correlations do not reach the 0.10 level of significance, but the trends in the two kinds of classes are consistent. That is, incompatible college-bound groups tend to dissolve the work association for short intervals to reduce tension. Noncollege groups, on the other hand, when faced with a conflict situation resort to general task-oriented activity to reduce tension.

Summary

The investigation sought to evaluate the proposition: if the compatibility of one group, *a*, is greater than that of another group, *b*, then the goal achievement of *a* will exceed that of *b*.

Compatibility for a group was defined mathematically on the basis of scores on the Control-scale of the FIRO–B. Results suggest that for noncollege-bound groups the proposition should be reversed, i.e., the goal achievement of incompatible groups tended to exceed that of compatible groups. Evidence for college-bound groups is not conclusive, but the trend of the data tends to support the proposition, namely, goal achievement is positively correlated with predicted compatibility.

Suggestion for Further Research

There is reason to think that certain of the BSCS laboratory blocks place more stress on the group structure than do others. This happens by virtue of the kinds of tasks to be accomplished, the complexity of the sequencing of tasks necessary to accomplish the experiments, and the amount of time over which data must be accumulated. Unfortunately, the block program available for the study reported in this paper minimized this stress and so provided a less sensitive situation in which to test the proposition regarding group productivity and compatibility. We are suggesting that the blocks vary in the stress they place on groups and that the incidence of "Sick" groups will be found to rise as a function of block program complexity. We also suspect that more applied studies of small group theory may provide useful information concerning the problem of maximizing task behavior in noncollege-bound groups.

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References

1. Bales, Robert F., *Interaction Process Analysis: A Method for the Study of Small Groups*, Addison-Wesley, Cambridge, 1950.

2. Follansbee, Harper, *Animal Behavior* Revised Experimental Edition, Biological Sciences Curriculum Study, Boulder, Colorado, 1964.

3. Schutz, William C., *FIRO: A Three-Dimensional Theory of Interpersonal Behavior*. Rinehart, New York, 1958.

4. Bales, Robert F., "A Set of Categories for the Analysis of Small Group Interaction," *Am. Sociol. Rev.*, **15**, 257–263 (1950). During the six weeks, observers 'took' 5–7 minute samples of interactions in each group at regular intervals.